GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Heat exchangers, PG_00055941 | | | | | | |
| Field of study | Power Engineering, Power Engineering, Power Engineering | | | | | | |
| Date of commencement of studies | October 2022 | | | Academic year of realisation of subject | | 2024/2025 | |
| Education level | first-cycle studies | | | Subject group | | Optional subject group<br>Subject group related to scientific research in the field of study | |
| Mode of study | Full-time studies | | | Mode of delivery | | at the university | |
| Year of study | 3 | | | Language of instruction | | Polish | |
| Semester of study | 6 | | | ECTS credits | | 2.0 | |
| Learning profile | general academic profile | | | Assessment form | | assessment | |
| Conducting unit | Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | | dr inż. Michał Pysz | | | |
| | Teachers | | | dr inż. Michał Pysz | | | |
| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 15.0 | 0.0 | 0.0 | 15.0 | 0.0 | 30 |
| | E-learning hours included: 0.0 | | | | | | |
| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | | Participation in consultation hours | Self-study | | SUM |
| | Number of study hours | 30 | | 2.0 | 18.0 | | 50 |
| Subject objectives | Presentation of the main heat and mass transfer mechanisms and laws. The lecture introduces the methods of solving the issues of heat conduction, convection, and radiative transfer. The basis for calculating heat exchangers. | | | | | | |

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<tr><td>Learning outcomes</td><td>
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<tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr>
<tr><td>[K6_W06] knows classic and developmental energy technologies, rules for the selection and operation of heat and energy devices and installations, basic principles of energy systems operation, basic issues regarding the reliability of energy devices and diagnostics, environmental effects of energy technologies used, methods of using renewable energy sources</td><td>will be able to design a simple device and prepare its technical documentation, carry out basic technical and economic analysis of energy systems, including renewable, conventional and nuclear energy.</td><td>[SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge</td></tr>
<tr><td>[K6_W09] knows the dangers of electrical devices and the principles of protection against them, has basic knowledge of heat exchangers, has basic knowledge of power equipment such as pumps, compressors, turbines, combustion engines, boilers, pipelines and their accessories and methods of their selection depending on the needs</td><td>has a basic knowledge of<br>of heat exchangers, and<br>methods of selecting them<br>according to<br>needs</td><td>[SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge</td></tr>
<tr><td>[K6_U04] is able to design a simple device structure and prepare the accompanying technical documentation, conduct a basic technical and economic analysis of energy systems, including technologies using renewable and pro-ecological energy sources as well as conventional and nuclear energy, design energy installations for them and their basic elements (including electric lighting) ); select, operate and control the most commonly used electrical devices and drive systems.</td><td>will be familiar with classical and perspective energy technologies, the principles of selection and operation of thermal-energy equipment and installations, basic principles of operation of energy systems, environmental effects of applied energy technologies, ways of using renewable energy sources.</td><td>[SU5] Assessment of ability to present the results of task<br>[SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment</td></tr>
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<tr><td>Subject contents</td><td>Lecture - presentation of the main mechanisms and laws of heat transfer. Methods of solving the problems occurring in technology in terms of conduction, convection and radiation heat transfer. Methods of heat transfer intensification. Fundamentals of heat exchanger design. The project consists of designing a heat exchanger for a dedicated application.</td></tr>
<tr><td>Prerequisites<br>and co-requisites</td><td>mathematics I, II, III, physics, fluid mechanics, thermodynamics</td></tr>
<tr><td>Assessment methods<br>and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td></td><td>60.0%</td><td>60.0%</td></tr>
<tr><td></td><td>60.0%</td><td>40.0%</td></tr>
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</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1.Mikielewicz J., Grochal B., Gumkowski S., Polesek-Karczewska S.,Mikielewicz D., Wymiana ciepła, Wydawnictwo IMP PAN, 1996 2.F.Incropera, D. deWitt, Fundamentals of heat and mass transfer, 5thedition, CRC Press, 2007. 2.Wiśniewski S., Wiśniewski T., Wymianaciepła, WNT, 2007. 4.Pudlik W., Wymiana i wymienniki ciepła,Wydawnictwo PG, Gdańsk 1996.</td></tr>
<tr><td>Supplementary literature</td><td>Cengel, Y. A., & Ghajar, A. J. (2014). Heat and mass transfer: Fundamentals and applications (5th ed.). McGraw-Hill Professional.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
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| Example issues/ example questions/ tasks being completed | 1. Describe the known modes of heat transfer using the example of heat transfer through a multilayer wall separating two fluids at different temperatures.2. derive Peclet's equation for heat transfer through a single wall separating two fluids.3. define thermal resistance of heat conduction and convection heat transfer.4. State the definition of heat flux density in a two-dimensional temperature field.5. Discuss examples of geometric similarity, and why geometric similarity is not sufficient in the physical modelling of phenomena.6. Derive the concept of Biot number from the definition, explain how it differs from Nusselt number. 8. Derive an equation for calculating the time-varying temperature in a low thermal conductivity system, assuming that a body is cooled in a constant temperature medium.9. Derive the differential equation of the time-varying temperature field for the general case of a system with low thermal conduction resistance, taking into account radiative heat transfer and a constant heat flux.10. Give the heat flux formula for a unilaterally finned surface based on a sketch and an explanation.11. Discuss the forms of the Fourier-Kirchoff equation under appropriate assumptions, i.e. Fourier, Poisson and Laplace equations.12. Derive the differential equation for the temperature distribution in a rib and state the assumptions under which a rectangular rib can be analysed in this way. State the assumptions under which these equations are derived.13. Hydrodynamic and thermal boundary layer.14. Analogies between heat and momentum transfer. The purpose of their use. Give an example.15. List and discuss ways of determining the heat transfer coefficient.16. Give the mechanism of forced and free convection. Give a set of criterion numbers describing this type of heat transfer. Define these numbers.17. Droplet and membrane condensation. Give the assumptions for Nusselt's theory.18. Boiling in volume. Conditions for bubble growth. Give a division by fluid temperature and geometry. Discuss the boiling curve.19. Boiling in flow. Discuss the structures that occur when a fluid flows through a heated channel with low heat flux density. Give the temperature distribution of the fluid and wall and examples of the application of this case.20. Give the division of heat exchangers and the assumptions for the theoretical analysis of heat exchangers.21. Give the general algorithm for the calculation of heat exchangers.22. Logarithmic mean temperature difference. State the temperature distribution for co-current and counter-current flow. |
| Work placement | Not applicable |